

WHAT IS CLAIMED IS:

1. A drive circuit, comprising:

a plurality of digital-to-analog conversion circuits each of which selects one of different reference voltages according to a digital gradation signal and inserts resistors with resistance values corresponding to said gradation signal into a plurality of circuits connecting the selected reference voltages with a first output terminal or a second output terminal; and

a sampling circuit which connects said first output terminal to a plurality of signal lines one by one in response to a signal line selection signal synchronized with said gradation signal and connects said second output terminal to said plurality of signal lines one by one in response to said signal line selection signal,

wherein when said sampling circuit selects signal lines, the reference voltage selected by one of said digital-to-analog conversion circuits and/or the reference voltage selected by the other of said digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

2. A drive circuit, comprising:

a plurality of digital-to-analog conversion circuits each of which consists of a plurality of circuits containing a plurality of switching elements

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with conduction resistances different from one another and connecting different reference voltages with a first output terminal or a second output terminal and in which specified switching elements conduct according to a digital gradation signal; and

a sampling circuit which has a first group of sampling switching elements inserted between said first output terminal and a plurality of signal lines and a second group of sampling switching elements inserted between said second output terminal and said plurality of signal lines,

wherein said first group of sampling switching elements and said second group of sampling switching elements start to conduct one by one in response to a signal line selection signal synchronized with said gradation signal, and consequently the reference voltages connected to specified switching elements belonging to one of said digital-to-analog conversion circuits and/or the reference voltages connected to specified switching elements belonging to the other of said digital-to-analog conversion circuits are output to said signal lines via specified conducting switching elements.

3. A drive circuit, comprising:

a plurality of digital-to-analog conversion circuits each of which selects one of different reference voltages according to a digital gradation signal;

a plurality of variable resistor circuits which insert resistors with resistance values corresponding to said gradation signal into a plurality of circuits connecting the reference voltages selected by said digital-to-analog conversion circuits with a first output terminal or a second output terminal; and

a sampling circuit which connects said first output terminal to a plurality of signal lines one by one in response to a signal line selection signal synchronized with said gradation signal and connects said second output terminal to said plurality of signal lines one by one in response to said signal line selection signal,

wherein when said sampling circuit selects signal lines, the reference voltage selected by one of said digital-to-analog conversion circuits and/or the reference voltage selected by the other of said digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

4. A drive circuit, comprising:

a plurality of variable resistor circuits which insert resistors with resistance values corresponding to a digital gradation signal into a plurality of circuits connecting one of a plurality of digital-to-analog conversion circuits with a first output terminal and into a plurality of circuits connecting the other of the plurality of digital-to-

analog conversion circuits with a second output terminal, said plurality of digital-to-analog conversion circuits outputting an analog voltage by converting it into different reference voltages according to said digital gradation signal; and

a sampling circuit which has a first group of sampling switching elements inserted between said first output terminal and a plurality of signal lines and a second group of sampling switching elements inserted between said second output terminal and said plurality of signal lines,

wherein said first group of sampling switching elements and said second group of sampling switching elements start to conduct one by one in response to a signal line selection signal synchronized with said gradation signal and select the signal lines, and as a result of the signal line selection by said sampling circuit, the reference voltages outputted from one of said digital-to-analog conversion circuits and/or the reference voltages outputted from the other of said digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

5. The drive circuit according to claim 3, wherein said plurality of variable resistor circuits insert switching elements which conduct according to said gradation signal as the resistors with resistance values corresponding to said gradation signal.

6. The drive circuit according to claim 4, wherein said plurality of variable resistor circuits insert switching elements which conduct according to said gradation signal as the resistors with resistance values corresponding to said gradation signal.

7. The drive circuit according to claim 3, wherein said plurality of variable resistor circuits insert switching elements which conduct according to said gradation signal and resistance elements, connected in series with each other, as the resistors with resistance values corresponding to said gradation signal.

8. The drive circuit according to claim 4, wherein said plurality of variable resistor circuits insert switching elements which conduct according to said gradation signal and resistance elements, connected in series with each other, as the resistors with resistance values corresponding to said gradation signal.

9. A drive circuit, comprising:

a plurality of positive digital-to-analog conversion circuits each of which selects one of different positive reference voltages according to a digital gradation signal and inserts resistors with resistance values corresponding to said gradation signal into a plurality of circuits connecting the selected positive reference voltages with a first positive output terminal or second positive output

terminal;

a plurality of negative digital-to-analog conversion circuits each of which selects one of different negative reference voltages according to a digital gradation signal and inserts resistors with resistance values corresponding to said gradation signal into a plurality of circuits connecting the selected negative reference voltages with a first negative output terminal or second negative output terminal;

a positive sampling circuit which connects said first positive output terminal to a plurality of signal lines one by one in response to a positive signal line selection signal synchronized with said gradation signal and connects said second positive output terminal to said plurality of signal lines one by one in response to said positive signal line selection signal synchronized with said gradation signal; and

a negative sampling circuit which connects said first negative output terminal to a plurality of signal lines one by one in response to a negative signal line selection signal synchronized with said gradation signal and connects said second negative output terminal to said plurality of signal lines one by one in response to said negative signal line selection signal,

wherein when said positive sampling circuit

selects signal lines, the positive reference voltage selected by one of said positive digital-to-analog conversion circuits and/or the positive reference voltage selected by the other of said positive digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits, and

when said negative sampling circuit selects signal lines, the negative reference voltage selected by one of said negative digital-to-analog conversion circuits and/or the negative reference voltage selected by the other of said negative digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

10. A drive circuit, comprising:

a plurality of positive digital-to-analog conversion circuits each of which consists of a plurality of circuits containing a plurality of switching elements with conduction resistances different from one another and connecting different positive reference voltages with a first positive output terminal or a second positive output terminal and in which specified switching elements conduct according to a digital gradation signal;

a plurality of negative digital-to-analog conversion circuits each of which consists of a plurality of circuits containing a plurality of switching elements with conduction resistances

different from one another and connecting different negative reference voltages with a first negative output terminal or a second negative output terminal and in which specified switching elements conduct according to a digital gradation signal;

a positive sampling circuit which has a first group of positive sampling switching elements inserted between said first positive output terminal and a plurality of signal lines and a second group of positive sampling switching elements inserted between said second positive output terminal and said plurality of signal lines; and

a negative sampling circuit which has a first group of negative sampling switching elements inserted between said first negative output terminal and a plurality of signal lines and a second group of negative sampling switching elements inserted between said second negative output terminal and said plurality of signal lines,

wherein said first group of positive sampling switching elements and said second group of positive sampling switching elements start to conduct one by one in response to a signal line selection signal synchronized with said gradation signal, and consequently the positive reference voltages connected to specified switching elements belonging to one of said positive digital-to-analog conversion circuits and/or the positive reference voltages connected to specified

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switching elements belonging to the other of said positive digital-to-analog conversion circuits are output to said signal lines via specified conducting switching elements, and

said first group of negative sampling switching elements and said second group of negative sampling switching elements start to conduct one by one in response to the signal line selection signal synchronized with said gradation signal, and consequently the negative reference voltages connected to specified switching elements belonging to one of said negative digital-to-analog conversion circuits and/or the negative reference voltages connected to specified switching elements belonging to the other of said negative digital-to-analog conversion circuits are output to said signal lines via specified conducting switching elements.

11. A drive circuit, comprising:

a plurality of positive digital-to-analog conversion circuits each of which selects one of different positive reference voltages according to a digital gradation signal;

a plurality of negative digital-to-analog conversion circuits each of which selects one of different negative reference voltages according to a digital gradation signal;

a plurality of positive variable resistor circuits which insert resistors with resistance values

corresponding to said gradation signal into a plurality of circuits connecting the positive reference voltages selected by said positive digital-to-analog conversion circuits with a first positive output terminal or a second positive output terminal;

a plurality of negative variable resistor circuits which insert resistors with resistance values corresponding to said gradation signal into a plurality of circuits connecting the negative reference voltages selected by said negative digital-to-analog conversion circuits with a first negative output terminal or second negative output terminal;

a positive sampling circuit which connects said first positive output terminal to a plurality of signal lines one by one in response to a positive signal line selection signal synchronized with said gradation signal and connects said second positive output terminal to said plurality of signal lines one by one in response to said positive signal line selection signal; and

a negative sampling circuit which connects said first negative output terminal to a plurality of signal lines one by one in response to a negative signal line selection signal synchronized with said gradation signal and connects said second negative output terminal to said plurality of signal lines one by one in response to said negative signal line selection signal,

wherein when said positive sampling circuit selects signal lines, the positive reference voltage selected by one of said positive digital-to-analog conversion circuits and/or the positive reference voltage selected by the other of said positive digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits, and

when said negative sampling circuit selects signal lines, the negative reference voltage selected by one of said negative digital-to-analog conversion circuits and/or the negative reference voltage selected by the other of said negative digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

12. A drive circuit, comprising:

a plurality of positive variable resistor circuits which insert resistors with resistance values corresponding to a digital gradation signal into a plurality of circuits connecting one of a plurality of positive digital-to-analog conversion circuits with a first positive output terminal and into a plurality of circuits connecting the other of the plurality of positive digital-to-analog conversion circuits with a second positive output terminal, said plurality of positive digital-to-analog conversion circuits outputting an analog voltage by converting it into different positive reference voltages according to said

digital gradation signal;

a plurality of negative variable resistor circuits which insert resistors with resistance values corresponding to a digital gradation signal into a plurality of circuits connecting one of a plurality of negative digital-to-analog conversion circuits with a first negative output terminal and into a plurality of circuits connecting the other of the plurality of negative digital-to-analog conversion circuits with a second negative output terminal, said plurality of negative digital-to-analog conversion circuits outputting an analog voltage by converting it into different negative reference voltages according to said digital gradation signal;

a positive sampling circuit which has a first group of positive sampling switching elements inserted between said first positive output terminal and a plurality of signal lines and a second group of positive sampling switching elements inserted between said second positive output terminal and said plurality of signal lines; and

a negative sampling circuit which has a first group of negative sampling switching elements inserted between said first negative output terminal and a plurality of signal lines and a second group of negative sampling switching elements inserted between said second negative output terminal and said plurality of signal lines,

said first group of negative sampling switching elements and said second group of negative sampling switching elements start to conduct one by one in response to the signal line selection signal synchronized with said gradation signal and select the signal lines, and as a result of the signal line selection by said negative sampling circuit, the negative reference voltage selected by one of said negative digital-to-analog conversion circuits and/or the negative reference voltage selected by the other of said negative digital-to-analog conversion circuits are output to said signal lines via the resistor inserted into any of said circuits.

14. The drive circuit according to claim 10, wherein said plurality of positive variable resistor circuits and said plurality of negative variable resistor circuits insert switching elements which conduct according to said gradation signal as the resistors with resistance values corresponding to said gradation signal.

16. The drive circuit according to claim 10, wherein said plurality of positive variable resistor circuits and said plurality of negative variable resistor circuits insert switching elements which conduct according to said gradation signal and resistance elements, connected in series with each other, as the resistors with resistance values corresponding to said gradation signal.

17. The drive circuit according to claim 2, wherein among the groups of the switching elements belonging to said sampling circuit, a pair of switching elements connected to the same signal line conduct simultaneously in response to said signal line selection signal.

18. The drive circuit according to claim 4, wherein among the groups of the switching elements belonging to said sampling circuit, a pair of switching elements connected to the same signal line conduct simultaneously in response to said signal line selection signal.

19. The drive circuit according to claim 8, wherein among the groups of the positive switching elements belonging to said positive sampling circuit, a pair of switching elements connected to the same signal line conduct simultaneously in response to said positive signal line selection signal and among the groups of the negative switching elements belonging to said negative sampling circuit, a pair of switching elements connected to the same signal line conduct simultaneously in response to said negative signal line selection signal.

20. The drive circuit according to claim 10, wherein among the groups of the positive switching elements belonging to said positive sampling circuit, a pair of switching elements connected to the same signal line conduct simultaneously in response to said

21. The drive circuit according to claim 2, wherein said switching elements are constituted of thin-film transistors.

23. The drive circuit according to claim 8, wherein said switching elements are constituted of thin-film transistors.

24. The drive circuit according to claim 10, wherein said switching elements are constituted of thin-film transistors.

25. The drive circuit according to claim 1,
wherein said plurality of reference voltages are fewer
in number than the gradations of displayed images.

26. The drive circuit according to claim 2,
wherein said plurality of reference voltages are fewer
in number than the gradations of displayed images.

27. The drive circuit according to claim 3,
wherein said plurality of reference voltages are fewer
in number than the gradations of displayed images.

28. The drive circuit according to claim 4,

wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

29. The drive circuit according to claim 7, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

30. The drive circuit according to claim 8, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

31. The drive circuit according to claim 9, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

32. The drive circuit according to claim 10, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

33. An image display apparatus equipped with the drive circuit according to claim 1, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, an electro-optical conversion element which changes its light transmittance or emission intensity in response to an electrical signal is placed near each intersection of the signal lines and scanning lines on said substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

34. An image display apparatus equipped with the

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35. An image display apparatus equipped with the drive circuit according to claim 3, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, an electro-optical conversion element which changes its light transmittance or emission intensity in response to an electrical signal is placed near each intersection of the signal lines and scanning lines on said substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

36. An image display apparatus equipped with the drive circuit according to claim 4', wherein a plurality of signal lines for transmitting image signals and a

display area of a substrate, an electro-optical conversion element which changes its light transmittance or emission intensity in response to an electrical signal is placed near each intersection of the signal lines and scanning lines on said substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

39. An image display apparatus equipped with the drive circuit according to claim 9, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, an electro-optical conversion element which changes its light transmittance or emission intensity in response to an electrical signal is placed near each intersection of the signal lines and scanning lines on said substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

40. An image display apparatus equipped with the drive circuit according to claim 10, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, an electro-optical conversion element which changes its

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light transmittance or emission intensity in response to an electrical signal is placed near each intersection of the signal lines and scanning lines on said substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

41. An image display apparatus equipped with the drive circuit according to claim 7, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, liquid crystals which change their light transmittance in response to an electrical signal are placed near each intersection of the signal lines and scanning lines on said substrate, said liquid crystals are sandwiched between said substrate and another substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

42. An image display apparatus equipped with the drive circuit according to claim 8, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, liquid crystals which change their light transmittance in response to an electrical signal are placed near each intersection of the signal lines and scanning lines on said substrate,

said liquid crystals are sandwiched between said substrate and another substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

43. An image display apparatus equipped with the drive circuit according to claim 9, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, liquid crystals which change their light transmittance in response to an electrical signal are placed near each intersection of the signal lines and scanning lines on said substrate, said liquid crystals are sandwiched between said substrate and another substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

44. An image display apparatus equipped with the drive circuit according to claim 10, wherein a plurality of signal lines for transmitting image signals and a plurality of scanning lines for transmitting scanning signals are formed in a matrix-like fashion in an image display area of a substrate, liquid crystals which change their light transmittance in response to an electrical signal are placed near each intersection of the signal lines and scanning lines on said substrate, said liquid crystals are sandwiched between said substrate and another

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substrate, said signal lines are connected to said drive circuit, and said scanning lines are connected to a scanning circuit.

45. The image display apparatus according to claim 41, wherein said switching elements are constituted of thin-film transistors.

46. The image display apparatus according to claim 42, wherein said switching elements are constituted of thin-film transistors.

47. The image display apparatus according to claim 43, wherein said switching elements are constituted of thin-film transistors.

48. The image display apparatus according to claim 44, wherein said switching elements are constituted of thin-film transistors.

49. The image display apparatus according to claim 41, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

50. The image display apparatus according to claim 42, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

51. The image display apparatus according to claim 43, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images.

52. The image display apparatus according to

claim 44, wherein said plurality of reference voltages are fewer in number than the gradations of displayed images..

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